

**RESEARCH AND TECHNOLOGY  
ADVISORY COMMITTEE  
ON  
MATERIALS AND STRUCTURES**

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**REPORT OF MEETING**

**FEBRUARY 6 and 7, 1973**



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ADVISORY COMMITTEE ON MATERIALS AND  
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OFFICE OF AERONAUTICS & SPACE TECHNOLOGY  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND TECHNOLOGY  
ADVISORY COMMITTEE  
ON  
MATERIALS AND STRUCTURES

REPORT OF MEETING  
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OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

## SUMMARY

The sixth meeting of the NASA Research and Technology Advisory Council, Committee on Materials and Structures was held on February 6 and 7, 1973 at the Langley Research Center, Hampton, Virginia. The meeting was open to the public.

The Committee concluded action on the report of the Ad Hoc Panel on Fracture Control by accepting the report and recommending:

1. Implementation of the Panel's recommendations by NASA insofar as practical.
2. Statement to be added to the report concerning quality, balance, and objectives of the NASA program.

The Committee also discussed problems in aerospace vehicle dynamics and control, IPAD, and tramp elements in fuels.

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Vehicle Dynamics and Control
- B. Agenda for Langley Review

NASA RESEARCH AND TECHNOLOGY ADVISORY COUNCIL,  
COMMITTEE ON MATERIALS AND STRUCTURES

Chairman - Mr. Ira G. Hedrick  
Grumman Aerospace Corporation

Members

Dr. George S. Ansell  
Rensselaer Polytechnic Institute

Dr. Robert I. Jaffee  
Battelle Memorial Institute

Mr. Louis P. Jahnke  
General Electric Company

Dr. Richard H. MacNeal  
MacNeal-Schwendler Corporation

Dr. James W. Mar  
Massachusetts Inst. of Tech.

Mr. Charles W. Rogers  
General Dynamics, Convair

Mr. Edwin M. Ryan  
Naval Air Systems Command

Col. Richard K. Saxer  
Air Force Materials Lab.

Mr. Howard J. Siegel  
McDonnell-Douglas Corp.

Mr. William T. Simpson  
Eastern Airlines, Inc.

Mr. M. Jonathan Turner  
The Boeing Company

NASA Members

Mr. G. Mervin Ault  
Lewis Research Center

Dr. George W. Brooks  
Langley Research Center

Mr. Charles E. Cataldo  
Marshall Space Flight Center

Dr. John A. Parker  
Ames Research Center

Mr. Robert E. Vale  
Manned Spacecraft Center

Executive Secretary - Mr. George C. Deutsch  
NASA Headquarters, OAST

Recording Secretary - Mr. Norman J. Mayer  
NASA Headquarters, OAST

Guest - Mr. William F. Brown, Jr., Lewis Research Center

Visitor - Mr. Carl M. Hanson - McDonnell-Douglas Corporation

## ROLL CALL

The sixth meeting of the NASA Research and Technology Advisory Council (RTAC), Committee on Materials and Structures was convened at 8:30 AM, February 6, 1973 at the NASA Langley Research Center, Hampton, Virginia. The meeting was attended by all members and several Langley Center personnel. It was also open to public attendance. The Committee was welcomed by Mr. Oran W. Nicks, Deputy Director of the Langley Center. New members of the Committee were introduced.

## CHAIRMAN'S REPORT

The Chairman summarized the results of the last meeting of the Committee and the RTAC. He also announced the RTAC approval for formation of the Joint Ad Hoc Panel on Aerospace Vehicle Dynamics and Control.

## SECRETARY'S REPORT

Mr. Deutsch reported on recent organizational adjustments and personnel reductions within NASA and reviewed the recently released 1974 budget plans and their implications for materials and structures research and development.

## AD HOC PANELS

### Basic Materials Research

The RTAC Committee on Research has approved the final report of the Ad Hoc Panel and has transferred the report, together with rebuttal comments from the Committee on Materials and Structures, to the RTAC for information.

### Fracture Control

Background information concerning the activities and reports of the Ad Hoc Panel on Fracture Control was presented by Mr. Jahnke, the Panel Chairman. This included a review of the comparisons of the recommendations of the original Panel report to the Committee with a NASA working group report concerning present and planned NASA effort. The comparison was made by the Committee members during and following the previous (fifth) meeting of the Committee. A supplementary NASA response containing description of personnel and projects and a bibliography of NASA reports and papers was sent to the Panel Chairman and the rest of the Committee members prior to the meeting. Members of the Panel were also requested to review the NASA response and submit their comments to the Panel Chairman.

After considerable discussion of the various points raised by Panel members and by NASA representatives, the Chairman requested Mr. Jahnke and Dr. Ansell to prepare a statement for Committee endorsement. A final statement of recommendations was adopted as follows:

"Whereas the Ad Hoc Panel on Fracture Control has issued a report of its findings and recommendations in October 1971, and the NASA Centers have had and taken the opportunity to both respond and react to these findings and recommendations, and

whereas the report of the Ad Hoc Panel on Fracture Control, together with the NASA Center responses, have already acted as stimuli for substantial further consideration and action on this topic,

the Materials and Structures Committee now accepts the Ad Hoc Panel report on Fracture Control of October 1971 and recommends that:

1. The recommendations of the report be implemented by NASA insofar as is practical
2. The NASA Center responses and actions already taken be attached to and considered as an addendum to the Ad Hoc Panel Report
3. The following commentary and recommendations be added to this combined report:
  - a. 'The NASA programs in the area of fracture control technology individually appear to be of high quality. Both the personnel and their productivity are commendable.
  - b. Both the Panel's report and the NASA response address, but do not resolve, the questions raised as to the adequacy of the overall effort, nor the proper balance of emphasis on the technical needs. Nor is it apparent that a method exists to make these judgements in the future. In this field, the cost of past failures which could have been avoided by the use of existing technology, and also the need



for increased reliability in advanced systems, provide very strong motivations for the establishment of a truly adequate and properly balanced assignment of resources.

- c. NASA-OAST prepare and keep current a short overall statement of NASA's responsibilities and objectives in fracture control technology, and in general how and when these shall be accomplished. This philosophical statement of the overall program objectives, in the context of both NASA responsibilities, and also an assessment of the efforts and accomplishments of others, would provide both a focus which does not now exist for consideration of adequate balance and level, as well as a yardstick to assess future expectations and performance.'

- 4. The Committee hereby concludes its study of NASA's effort in fracture technology."

#### Joint Panel on Aerospace Vehicle Dynamics and Control

The Panel was established December 1972. Members are listed in Appendix A. The first meeting was held at the Ames Research Center on January 16 and 17, 1973. Mr. Turner reviewed the charge to the Panel and some past history concerning major interdisciplinary problems and research efforts. The Panel meeting emphasized the great need for improving theory and analysis to agree with flight measurements. Although the basic technology is now available for integrating dynamics and control, it cannot be applied to complex systems without test article verification. Models incorporating all the important basic features can be used, but real flight data are still required to close the loop.

Copies of the minutes of the Panel meeting were distributed to the Committee. The next meeting of the Panel was scheduled for February 21 and 22 at NASA Headquarters.

#### INTEGRATED PROGRAM FOR AEROSPACE VEHICLE DESIGN (IPAD)

Reports describing computer programs for aircraft design were distributed to all Committee members, prior to the meeting, by the Chairman and the Secretary as background for hearing and discussing a presentation on IPAD by Mr. Harvey G. McComb, Jr. of the Langley Center. Prior to the presentation, Dr. Brooks reviewed the philosophy regard-

ing the NASA role in the project. He emphasized that the effort would be concentrated on the development of a tool for design and not the actual design of aircraft. The project effort would not produce a super computer program, but would involve development of an executive routine using existing programs. IPAD could be provided directly to users or made available through a service agency.

Mr. McComb's presentation included a background review of the movement in industry toward integrated computer aided analysis and design for various applications, as operational requirements become more complex and numerous. The prime advantage for the future was in the reduction of man hours involved in design. It was envisioned that the project development would reach maturity during the next decade. It would provide a more efficient alternative to the present method of only manual interdisciplinary coordination of the design process. Various disciplinary elements and their associated computer modules would be integrated, utilizing a data base manager (with data base libraries), utilities (software required for displays), and an executive routine as unique IPAD elements. The system would allow use of whatever specific modules were required, including proprietary modules.

An estimate of the technical capability for design and the proportion of the total task which can be computerized was shown. Examples comparing steps that can be accomplished at various levels of design were also shown.

The present phase, definition studies, will be completed by June 1973. Future in-house work will include development of more discipline interfaces, increases in the efficiency and capability of the structures module, and integration of visual displays into systems.

During discussion of the presentation, Committee members raised questions regarding the innovative aspects of the design process and whether this aspect would be lost. It was also felt that an automated process may eliminate decision making on the part of the project manager. Project personnel responded to the effect that innovation and creative ideas would not be eliminated, that new opportunities for their incorporation would be provided. Dr. MacNeal pointed out that many elements cannot be digitized, such as films and drawings, and that several manual interfaces would be required in the decision process.

Reproduction of the charts and figures used during the presentation were given to all Committee members. The Chairman requested future reports from NASA when significant progress has been made.

## TRAMP ELEMENTS IN FUELS AND ALLOYS

A primer on fuel differences and their effects on materials was sent to all members prior to the meeting. Dr. Ansell discussed the subject at the meeting and presented copies of a paper by C. C. Ward, Bureau of Mines, "Survey of Trace Metals in Distillate Fuels". (ASTM Symposium, June 28-29, 1972). In discussing the points made in the paper, Dr. Ansell concluded that trace element concentrations in distillate products, such as fuels, were well below amounts allowed by ASTM standards when processed from crude oils. The primary problem occurs in the transportation of fuels in pipe lines and tankers where both sea water and residual fuels can be contaminants. He felt that these problems can be controlled and therefore did not recommend further action by the Committee at this time. A future problem may arise from the use of ecological additives in fuels.

## NASA CENTER REPORTS

Langley - As part of his report to the Committee, Dr. Brooks arranged for specific visual and oral presentations to be made at several laboratory locations at the Langley Center. An agenda for these presentations is shown in Appendix B. These included a review of the NASTRAN program development, high temperature structures research, fatigue and fracture studies, composite materials projects, and aircraft and spacecraft dynamics and aero-elasticity.

Copies of a Center status report were also distributed to the Committee prior to the meeting. Dr. Brooks offered to brief the Committee on the structural and dynamic research effort in the YF-12 program at a future meeting.

Lewis - Prior to the meeting, Mr. Ault sent a letter of information to all members concerning hot-salt-stress corrosion of titanium alloys. This letter followed prior correspondence to the Committee reporting research on the subject. The letter contained responses from Committee members and comments from members of previous committees. The letter also contained a list of Lewis Center publications on the subject.

During the meeting, Mr. Ault showed vugraphs highlighting some of the work reported in his Center Member's report which was also distributed prior to the meeting.

Ames - Dr. Parker discussed several items in addition to the research described in his Center Member's report. These included toxic effects in fires, composite materials, and foam development.

Marshall - Mr. Cataldo forwarded a Center report prior to the meeting and also included an MSFC public affairs document on experiments to be included in the Skylab program. Reference was made to a NASA report, TMX 64706, "Assessment Of and Standardization For Quantitative Non-destructive Testing", by Neuschaffer and Beal of MSFC.

Manned Spacecraft Center - Mr. Vale distributed copies of a report summarizing recent studies of materials for the Shuttle Orbiter thermal protection system and on impulse transfer function analytical methods.

#### MEMBERS' REPORTS

Written reports were received from Members Hedrick, Mar, Rogers, Ryan, and Siegel. The highlights of these reports and other information were discussed during the meeting.

Dr. Jaffee reviewed the present titanium industry status with regard to common problems, overcapacity, and foreign sources. He distributed a Battelle document describing a proposed research program on the establishment of a titanium center. He noted that at present there was no prospect of an industry association and that a center was needed to maintain a viable domestic titanium industry capable of providing for the Government's needs and to encourage development of additional civil markets.

He noted the formation of an NMAB Committee on process control of titanium.

Mr. Jahnke distributed data on a new General Electric developed alloy (Ti 17). He also distributed copies of a report on the importance of processing technology in the future development of superalloys and the gas turbine which he prepared for an international superalloy symposium.

Mr. Rogers furnished the Committee with two reports on fracture control in composite structures. He noted that improved fracture control with composites can be obtained by the use of buffer strips as crack arrestors. This information was offered in contrast to other data presented during the Langley Center review which showed the occurrence of brittle failures in certain composites. The Chairman

requested a more detailed report on this subject during the next meeting and suggested that Mr. Rogers collaborate with the Langley Center personnel on its preparation. Mr. Rogers asked for more evidence concerning specific NASA long term goals and objectives toward which present and future research and development programs will be aimed.

Mr. Ryan supplemented his member's report with a film showing operation of an airplane drop test facility developed by the Ling-Temco-Vought Corporation for Navy carrier landing simulation.

Dr. MacNeal described recent work on NASTRAN improvements, including development of an aeroelastic module.

#### PLANS FOR NEXT MEETING

The next meeting was planned for May 22 and 23, 1973 at the Ames Research Center. The agenda would include the following items:

Joint Panel on Aerospace Vehicle Dynamics and Control -  
Presentation, discussion, and recommendations  
concerning preliminary report of Joint Panel.

Composite Materials Fracture Control -  
Further discussion of fracture characteristics  
of various composites and methods of control.

The meeting was adjourned at 3:00 PM, February 7, 1973.

Respectfully submitted,



Norman J. Mayer  
Recording Secretary

NASA RESEARCH AND TECHNOLOGY ADVISORY COUNCIL,

COMMITTEE ON MATERIALS AND STRUCTURES  
COMMITTEE ON GUIDANCE, CONTROL, AND INFORMATION SYSTEMS  
COMMITTEE ON AERONAUTICS  
COMMITTEE ON SPACE VEHICLES

JOINT AD HOC PANEL ON AEROSPACE VEHICLE DYNAMICS AND CONTROL

Co-Chairmen

M. Jonathan Turner - Materials and Structures Committee  
The Boeing Company

and

William L. Holladay - Guidance, Control, and Information  
Systems Committee  
North American Rockwell

Members

Dr. Daniel B. DeBra - Space Vehicles Committee  
Stanford University

William T. Hamilton - Aeronautics Committee  
The Boeing Company

Bert M. Hall  
McDonnell-Douglas Astronautics Company

Prof. John J. Deyst  
Massachusetts Institute of Technology

John H. Watson  
General Dynamics, Convair Aerospace Division

Col. Frank L. Young  
Wright-Patterson Air Force Base

Secretary - Norman J. Mayer  
NASA Headquarters

AGENDA FOR  
LANGLEY RESEARCH CENTER PROGRAM REVIEW

February 6, 1973

<u>Speaker</u>	<u>Title</u>	<u>Location</u>
J. P. Raney	NASTRAN Status	8-Foot High Temperature Structures Tunnel
R. R. Howell	High Temperature Structures	Same
H. F. Hardrath	Fatigue and Fracture	Fatigue Laboratory
E. E. Matthauser	Composites	Same
H. G. Morgan	Aircraft Dynamics and Aeroelasticity	Transonic Dynamics Tunnel
H. G. Morgan	Space Vehicle Dynamics and Aeroelasticity	Same